

Claims

- 1 A medicament dispenser comprising:
- (i) a housing having an outlet;
 - 5 (ii) a medicament container locatable within said housing;
 - (iii) an electronic dose counter associated with said outlet; wherein said dose counter comprises a first sensor for directly detecting a medicament release dispensable from said medicament container through said outlet; and
 - (iv) means for detecting changes in the performance of the sensor attributable to
 - 10 contamination or degradation and for adjusting the operation of the dispenser to compensate, at least in part, for said changes.
2. A dispenser according to claim 1 wherein said means for detecting changes in the performance of the sensor comprises electronic means, utilising the sensor, for
- 15 taking a calibration reading prior to the dispensing of a dose of medicament.
3. A dispenser according to claim 2 further comprising means for comparing the calibration reading with a predetermined threshold value indicative of satisfactory operation of the sensor and for changing an operating characteristic of the sensor
- 20 and/or of one or more electronic components associated therewith, in the event that the comparison indicates a change from said satisfactory operation, in a sense tending to restore satisfactory operation of the sensor.
4. A dispenser according to claim 3 wherein the sensor includes an emitter and
- 25 a detector of a beam of radiation, such as infra red radiation, and the said operating characteristic comprises the magnitude of driving current pulses applied to the emitter.
5. A dispenser according to claim 4 including means for deriving said calibration
- 30 reading from electrical signals derived from the detector in response to radiation emitted by the emitter in response to said current pulses.

6. A dispenser according to claim 4 or claim 5 including means for progressively increasing the magnitude of said current from a starting level until said calibration reading matches said threshold level.

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7. A dispenser according to claim 6, wherein the means for progressively increasing the magnitude of said current effects said increase step-wise.

8. A dispenser according to claim 7 wherein the steps are substantially equal in
10 magnitude.

9. A dispenser according to claim 2 or claim 3 wherein said electronic means comprises part of a servo system that directly compensates for changes in performance as they occur.

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10. A dispenser according to any of claims 2 to 9 wherein said electronic means includes a microprocessor.

11. A medicament dispenser comprising:

20 (i) a housing having an outlet;

(ii) a medicament container locatable within said housing;

(iii) an electronic dose counter associated with said outlet; wherein said dose counter comprises a first sensor for directly detecting a medicament release dispensable from said medicament container through said outlet; and

25 (iv) means for resisting deposition of contaminants at locations capable of adversely affecting the detection of said release by said sensor.

12. A dispenser according to claim 11 wherein said means for resisting deposition of contaminants comprises one or more non-adhesive coatings of materials such as
30 Teflon (Registered Trade Mark), other fluoropolymers and/or anti-static agents, hydrophobic or hydrophilic materials applied to a surface at risk of contamination.

13. A dispenser according to claim 11 or claim 12 wherein said means for resisting deposition of contaminants comprises one or more of baffles, bluff bodies and other physical barriers or guides disposed and/or configured to obstruct the
5 passage of contaminants toward said locations and/or to positively divert said contaminants away from said locations.

14. A dispenser according to any of claims 11 to 13 wherein said means for resisting deposition of contaminants comprises suitably placed and configured air
10 inlets to permit clean air to be drawn past said locations when a patient applies suction to a mouthpiece of the dispenser whereby the dispenser is used to deliver a dose of medicament through said outlet.

15. A medicament dispenser comprising:
15 (i) a housing having an outlet;
(ii) a medicament container locatable within said housing;
(iii) an electronic dose counter associated with said outlet; wherein said dose counter comprises a first sensor for directly detecting a medicament release dispensable from said medicament container through said outlet; and
20 (iv) means for removing, at least in part, contaminants deposited at locations capable of adversely affecting the detection of said release by said sensor.

16. A dispenser according to claim 15, wherein the means for removing contaminants comprises means for applying heat to at least one said location.
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17. A dispenser according to claim 16, wherein microwires or a resistive layer are deposited on a surface disposed at said at least one location to form a local heater.

18. A dispenser according to claim 16, wherein a surface disposed at said at
30 least one location is coated, or otherwise treated, to encourage absorption of a proportion of a beam of energy used in the detection of said medicament release, or

of another beam of energy used in temporary substitution for the first-mentioned beam.

19. A dispenser according to claim 18 wherein, in the event that said another
5 beam of energy is employed, the energy of said another beam is of a different form
or of a different wavelength from that of the first-mentioned beam, and wherein the
said surface is treated with a material that absorbs the energy of the said another
beam to a useful extent, but does not significantly absorb the energy of the first-
mentioned beam.

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20. A dispenser according to claim 18 wherein, in the event that said another
beam of energy is employed, it is automatically generated at predetermined or
random intervals that are timed and/or controlled so as not to coincide with the
emission of the first-mentioned beam.

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21. A dispenser according to claim 18 wherein, in the event that said another
beam of energy is employed, it is generated, as part of a cleansing operation, only
when calibration readings indicate that contaminants have built up to an extent that
requires cleansing.

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22. A dispenser according to any of claims 15 to 21, wherein the means for
removing contaminants includes means for agitating components at or adjacent said
locations.

25 23. A dispenser according to claim 22 wherein the means for agitating includes a
piezoelectric or magnetostrictive material provided at or near a surface susceptible
of contamination, and means to apply electrical oscillation signals to the said
material, causing it to vibrate at one or more selected frequencies

30 24. A dispenser according to claim 23 wherein the piezoelectric or
magnetostrictive material is annular and disposed so as to directly surround at least

part of the surface, thereby to allow physical vibrations to be generated in extremely close proximity to said surface.

25. A dispenser according to claim 23 wherein piezoelectric material is deposited,
5 or mounted as a separate entity, directly on top of the surface.

26. A dispenser according to any of claims 15 to 25, wherein the means for removing contaminants includes means for scraping contaminants from said locations.

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27. A dispenser according to claim 26 wherein mechanically movable or electrically driven scraper devices are incorporated into the dispenser to enable contaminants to be physically scraped away from surfaces at risk.

15 28. A dispenser according to any of claims 15 to 27, wherein the means for removing contaminants includes means for generating or constraining an air flow to flush the contaminants away when the dispenser is used.

29. A dispenser according to claim 28, wherein an air flow is constrained to flow
20 over a surface at risk by way of one or more apertures formed near the outlet; said one or more apertures being appropriately sited, configured and dimensioned such that suction, applied to a mouthpiece of the dispenser by a patient, draws air in through the one or more apertures; suitable internal ducting being provided to convey the air so drawn in to the surface at risk of contamination.

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30. A medicament dispenser according to any preceding claim, wherein said sensor comprises an emitter and a detector.

31. A medicament dispenser according to claim 30, wherein the emitter emits
30 electromagnetic radiation.

32. A medicament dispenser according to claim 30 or claim 31, wherein the detector detects electromagnetic radiation.

33. A medicament dispenser according to claim 31 or claim 32 as dependent on claim 31, wherein the electromagnetic radiation emitted from the emitter is infrared,
5 visible or ultraviolet radiation.

34. A medicament dispenser according to claim 33, wherein the radiation is in the range of 0.95 μ m to 0.35 μ m.

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35. A medicament dispenser according to claim 34, wherein the radiation is in the infrared range.

36. A medicament dispenser according to claim 33, wherein the radiation has a
15 wavelength peak at about 0.88 μ m.

37. A medicament dispenser according to any one of claims 30 to 36, wherein the emitter is selected from the group consisting of light emitting diode, laser, incandescent lamp, electroluminescent or fluorescent light sources.

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38. A medicament dispenser according to claim 37, wherein the emitter further comprises a filter.

39. A medicament dispenser according to claim 38, wherein the filter is an optical
25 filter.

40. A medicament dispenser according to claim 39, wherein the optical filter is a polarising filter.

41. A medicament dispenser according to any one of claims 30 to 40, wherein the detector is selected from the group consisting of photodiode, phototransistor, light dependent resistor, pyroelectric detector and bolometer.

5 42. A medicament dispenser according to claim 41, wherein the detector further comprises a filter.

43. A medicament dispenser according to claim 42, wherein the filter is an electronic filter.

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44. A medicament dispenser according to claim 42, wherein the filter is an optical filter.

45. A medicament dispenser according to claim 44, wherein the optical filter is a
15 polarising filter.

46. A medicament dispenser according to any one of claims 30 to 45, wherein the detector is associated with an amplifier.

20 47. A medicament dispenser according to claim 46, wherein the amplifier is positioned close to the detector.

48. A medicament dispenser according to claim 46 or claim 47, wherein the amplifier is integrated with the detector.

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49. A medicament dispenser according to any one of claims 30 to 48, wherein the detector detects an increase in radiation compared to the amount of radiation emitted by the emitter.

50. A medicament dispenser according to any one of claims 30 to 48, wherein the detector detects a decrease in radiation compared to the amount of radiation emitted by the emitter.

5 51. A medicament dispenser according to claim 49 or claim 50, wherein the increase or decrease in detected radiation is due to interference of radiation reaching the detector by the medicament release.

52. A medicament dispenser according claim 51, wherein the interference is due
10 to absorption of radiation by the medicament release.

53. A medicament dispenser according claim 51, wherein the interference is due to scattering of radiation by the medicament release.

15 54. A medicament dispenser according claim 51, wherein the interference is due to reflection of radiation by the medicament release.

55. A medicament dispenser according claim 51, wherein the interference is due to refraction of radiation by the medicament release.

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56. A medicament dispenser according claim 51, wherein the interference is due to diffraction of radiation by the medicament release.

57. A medicament dispenser according to any one of claims 30 to 56, wherein the
25 amount of radiation reaching the detector is maintained at a substantially constant level by using an electronic feedback circuit to alter the level of radiation emitted by the emitter.

58. A medicament dispenser according to any one of claims 30 to 57, wherein the
30 first sensor further comprises a reflector to reflect radiation from the emitter to the detector.

59. A medicament dispenser according to any one of claims 30 to 58, wherein the emitter emits radiation of more than one wavelength and the detector detects radiation of more than one wavelength.

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60. A medicament dispenser according to claim 59, wherein the first sensor quantifies the concentration of medicament with the medicament release by measuring radiation at one or more wavelengths.

10 61. A medicament dispenser according to any one of claims 30 to 60, wherein the dispenser additionally comprises a second sensor for detecting a medicament release.

62. A medicament dispenser according to claim 61, wherein the second sensor
15 comprises an emitter and a detector.

63. A medicament dispenser according to claim 61 or claim 62, wherein the medicament release passes the second sensor subsequent to passing the first sensor.

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64. A medicament dispenser according to any one of claims 30 to 63, wherein the dispenser further comprises a third sensor.

65. A medicament dispenser according to claim 64, wherein the third sensor is
25 sensitive to parameter selected from the group consisting of electromagnetic radiation, magnetic field, electric field, light, motion, temperature, pressure, sound, oxygen concentration, carbon dioxide concentration and moisture.

66. A medicament dispenser according to claim 64 or claim 65, wherein the third
30 sensor responds to actuation of the dispenser.

67. A medicament dispenser according to any preceding claim, wherein the first sensor is integral with the outlet.

68. A medicament dispenser according to any one of claims 61 to 67, wherein the
5 second sensor is integral with the outlet.

69. A dispenser according to any preceding claim, wherein the first sensor is reversibly attachable to the outlet.

10 70. A medicament dispenser according to any one of claims 61 to 69, wherein the second sensor is reversibly attachable to the outlet.

71. A medicament dispenser according to any one of claims 64 to 70, wherein the third sensor is integral with the housing.

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72. A medicament dispenser according to any one of claims 64 to 70, wherein the third sensor is reversibly attachable to the housing.

73. A medicament dispenser according to any preceding claim, wherein the dose
20 counter is reversibly attachable to the housing.

74. A medicament dispenser according to any preceding claim, wherein the first sensor is located on the dose counter.

25 75. A medicament dispenser according to any one of claims 61 to 74, wherein the second sensor is located on the dose counter.

76. A medicament dispenser according to any preceding claim, wherein the dispenser further comprises one or more optical wave guides.

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77. A medicament dispenser according to claim 76, wherein the one or more optical wave guides are located on the housing.

78. A medicament dispenser according to claim 76 or claim 77, wherein the
5 optical wave guide is composed of an organic polymeric or inorganic glass fibre material.

79. A medicament dispenser according to any one of claims 76 to 78, wherein the medicament dispenser comprises a first and a second optical wave guide per
10 sensor.

80. A medicament dispenser according to claim 79, wherein the first optical wave guide channels radiation from the emitter to the outlet.

15 81. A medicament dispenser according to claim 79 or claim 80, wherein the second optical wave guide channels radiation from the outlet to the detector.

82. A medicament dispenser according to any one of claims 30 to 81, wherein the emitter and detector are located on the same side of the outlet.
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83. A medicament dispenser according to claim 82, wherein the radiation emitted from the emitter is reflected back to the detector by a reflective surface on the opposite side of the outlet to the emitter and detector.

25 84. A medicament dispenser according to claim 83, wherein the reflective surface is a surface of the outlet or is an additional component attached thereto.

85. A medicament dispenser according to any one of claims 82 to 84, wherein the emitter and detector are integrated into a single component.
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86. A medicament dispenser according to any preceding claim, wherein the sensor is controlled by a digital or computational semi-conductor device.

87. A medicament dispenser according to claim 86, wherein the digital or
5 computational semi-conductor device energises the sensor and associated electronic components to detect and respond to a medicament release every 0.1 to 100ms.

88. A medicament dispenser according to claim 86 or claim 87, wherein the
10 sensor and associated electronic components are energised for 1 to 100 μ s.

89. A medicament dispenser according to any one of claims 86 to 88, wherein the digital or computational semiconductor device returns the sensor to low power mode after a medicament release has been detected or a time-out period exceeded.

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90. A medicament dispenser according to any preceding claim, wherein the medicament container is an aerosol container.

91. A medicament dispenser according to claim 90, wherein the aerosol container
20 comprises a suspension of medicament in a propellant.

92. A medicament dispenser according to claim 91, wherein the propellant is selected from the group consisting of HFA134a, HFA227, carbon dioxide or a mixture thereof.

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93. A medicament dispenser according to claim 90, wherein the aerosol container comprises a solution of medicament in a solvent.

94. A medicament dispenser according to any one of claims 1 to 89, wherein the
30 medicament container is a dry-powder container.

95. A medicament dispenser according to claim 94, wherein the dry-powder container comprises a medicament and optionally excipient in dry-powder form.

96. A medicament dispenser according to any preceding claim, wherein the
5 dispenser is actuatable manually by the patient.

97. A medicament dispenser according to any one of claims 1 to 95, wherein the dispenser is actuatable by the application of non-mechanical energy to a coupling element.

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98. A medicament dispenser according to any one of claims 1 to 95, wherein the dispenser is actuatable by the application of mechanical energy to a coupling element.

99. A medicament dispenser according to claim 97 or 98, wherein the coupling
15 element is one or more shape memory alloy wires.

100. A medicament dispenser according to any one of claims 1 to 95, wherein the dispenser is actuatable by the application of non-mechanical energy to a drive means.

20 101. A medicament dispenser according to any one of claims 1 to 95, wherein the dispenser is actuatable by the application of mechanical energy to a drive means.

102. A medicament dispenser according to any preceding claim, wherein the medicament container further comprises a medicament selected from the group
25 consisting of albuterol, salmeterol, fluticasone propionate, beclomethasone dipropionate and salts and solvates and any mixtures thereof.

103. A medicament dispenser according to any preceding claim, wherein the outlet comprises a mouthpiece for inhalation therethrough.

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104. A medicament dispenser according to any preceding claim, wherein the dispenser additionally comprises a communicator for communication to enable transfer of data from the dose counter to an electronic data management system.

5 105. A medicament dispenser according to claim 104, wherein the data management system is a local data management system.

106. A medicament dispenser according to any one of claims 104 and 105, wherein the dispenser further comprises a communicator for wireless communication
10 with a gateway to a network computer system to enable transfer of data between the network computer and the electronic data management system.

107. A medicament dispenser substantially as herein described with reference to, and/or as shown in, Figures 7 to 10 of the accompanying drawings.